

Impact of CO₂ on Intracranial Hypertension in Spaceflight
Presenter David Alexander MD
Reviewer: Dr. Peter Bauer MD

The CO₂ section will discuss the history, mechanisms, and research dealing with the impact of CO₂ on astronauts exposed to long duration spaceflight

- ▶ CO₂ – Acute: Given the history of uneven removal of CO₂ from spacecraft areas, there is a history of acute illness that impacts short-term health and performance.
 - ▶ Acute CO₂ symptoms occur in space flight due to a combination of CO₂ scrubbing limitations, microgravity-related lack of convection, and possibly interaction with microgravity-related physiological changes.
 - ▶ Reported symptoms mainly include headaches, malaise, and lethargy. Symptoms are treatable with analgesics, rest, temporarily increasing scrubbing capability, and breathing oxygen. This does not treat the underlying pathology.
 - ▶ Recommended disposition: Conduct research to determine the optimal CO₂ levels that would prevent occurrence of symptoms.
- ▶ CO₂ – Chronic: Given prolonged exposure to elevated CO₂ levels, there is a history that the long-term health of the crew is impacted.
 - ▶ Chronic CO₂ exposures occur in space flight due to a combination of CO₂ scrubbing limitations and microgravity-related lack of convection, with possible contribution from microgravity-related physiological changes.
 - ▶ Since acute symptoms are experienced at levels significantly lower than expected, there are unidentified long-term effects from prolonged exposure to elevated CO₂ levels on orbit. There have been long term effects seen terrestrially and research needed to further elucidate long term effects on orbit.
 - ▶ Recommended disposition: Research required to further elucidate long term effects. In particular, elucidation of the role of elevated CO₂ on various levels of CO₂ vasodilatation of intracranial blood vessels and its potential contribution to elevation of intracranial pressure.

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CONTROL ID: 1004618

PRESENTATION TYPE: Panel Overview

CURRENT CATEGORY: Space Medicine

TITLE: Visual Impairment and Intracranial Hypertension: An emerging spaceflight risk (Part 1 of 2)

AUTHORS (FIRST NAME, LAST NAME): Jennifer A. Fogarty¹, James D. Polk¹, William J. Tarver¹, Charles R. Gibson¹, Ashot E. Sargsyan¹, Terrance A. Taddeo¹, David J. Alexander¹, Christian A. Otto¹

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INSTITUTIONS (ALL): 1. Space Life Sciences Directorate, NASA Johnson Space Center, Houston, TX, United States.

ABSTRACT BODY:

Panel Overview: What is the risk? Given that astronauts exposed to microgravity experience a cephalad fluid shift, and that both symptomatic and asymptomatic astronauts have exhibited optic nerve sheath edema on MRI, there is a high probability that all astronauts have some degree of increased intracranial pressure (ICP; intracranial hypertension), and that those susceptible (via eye architecture, anatomy, narrow optic disc) have a high likelihood of developing papilledema (optic disc edema, globe flattening), choroidal folds, and/or hyperopic shifts and that the degree of edema may determine long-term or permanent vision impairment or loss. Back to back panels on this topic have been developed to address this emerging risk. The first panel will focus on the 6 clinical cases with emphasis on ophthalmic findings and imaging techniques used pre-, in-, and post-flight. The second panel will discuss the operational mitigation and medical requirements, the potential role of CO2 on ISS, and the research approach being developed. In total these back to back panels will explore what is known about this risk, what has been done immediately to address it, and how an integrated research model is being developed.

First panel will be 1.5 hours and will focus on the review of the clinical issue.

Presentations (20 minutes each) include:

5 minute introduction: Dr. JA Fogarty

1. Dr. Bill Tarver: Clinical Overview (Dr. Polk as back up)

2. Dr. Bob Gibson: Ophthalmic review

3. Drs. Ashot Sargsyan & Doug Hamilton: Imaging

4. Discussion (25 minutes)

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CONTROL ID: 1004651

PRESENTATION TYPE: Panel Overview

CURRENT CATEGORY: Space Medicine

TITLE: Visual Impairment and Intracranial Hypertension: An emerging spaceflight risk (Part 2 of 2)

AUTHORS (FIRST NAME, LAST NAME): Jennifer A. Fogarty¹, James D. Polk¹, William J. Tarver¹, Charles R. Gibson¹, Ashot E. Sargsyan¹, Terrance A. Taddeo¹, David J. Alexander¹, Christian A. Otto¹

CONTACT (E-MAIL ONLY): elkin.romero-1@nasa.gov

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Panel Overview: What is the risk? Given that astronauts exposed to microgravity experience a cephalad fluid shift, and that both symptomatic and asymptomatic astronauts have exhibited optic nerve sheath edema on MRI, there is a high probability that all astronauts have some degree of increased intracranial pressure (ICP; intracranial hypertension), and that those susceptible (via eye architecture, anatomy, narrow optic disc) have a high likelihood of developing papilledema (optic disc edema, globe flattening), choroidal folds, and/or hyperopic shifts and that the degree of edema may determine long-term or permanent vision impairment or loss. Back to back panels on this topic have been developed to address this emerging risk. The first panel will focus on the 6 clinical cases with emphasis on ophthalmic findings and imaging techniques used pre-, in-, and post-flight. The second panel will discuss the operational mitigation and medical requirements, the potential role of CO₂ on ISS, and the research approach being developed. In total these back to back panels will explore what is known about this risk, what has been done immediately to address it, and how an integrated research model is being developed.

The second panel will also be 1.5 hours.

Presentations (20 minutes each) include:

5 minute introduction: Dr. JA Fogarty

1. Dr. Terry Taddeo: Ops mitigations/medical requirements
2. Dr. David Alexander: Potential Role of CO₂
3. Dr. Christian Otto: Research Plan
4. Discussion (25 minutes)

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